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(54) **WASHER FOR A DEGRADATION ASSEMBLY**

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(58) **Field of Classification Search** 299/104, 299/106, 107, 95

See application file for complete search history.

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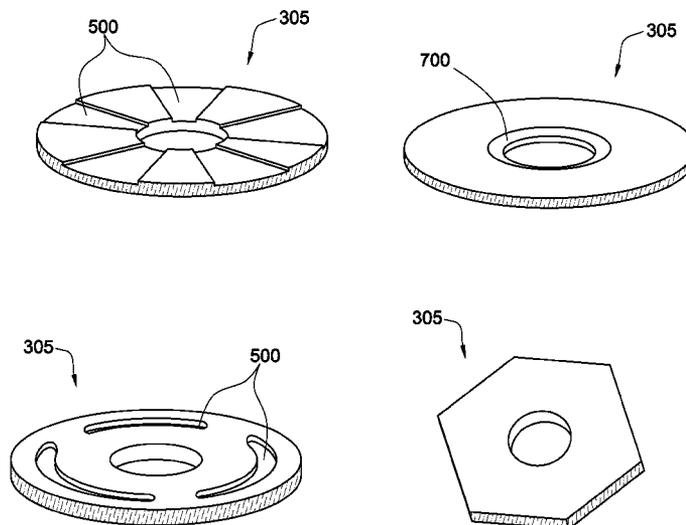
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(57) **ABSTRACT**

In one aspect of the invention, a degradation assembly has an attack tool with a body and a shank, the body having a wear-resistant tip. The shank is disposed within a bore of a holder secured to a driving mechanism. A washer is positioned in-between the attack tool and the holder and fitted around the shank of the attack tool, wherein an outer edge of the washer has a hardness greater than 58 HRC.

18 Claims, 15 Drawing Sheets



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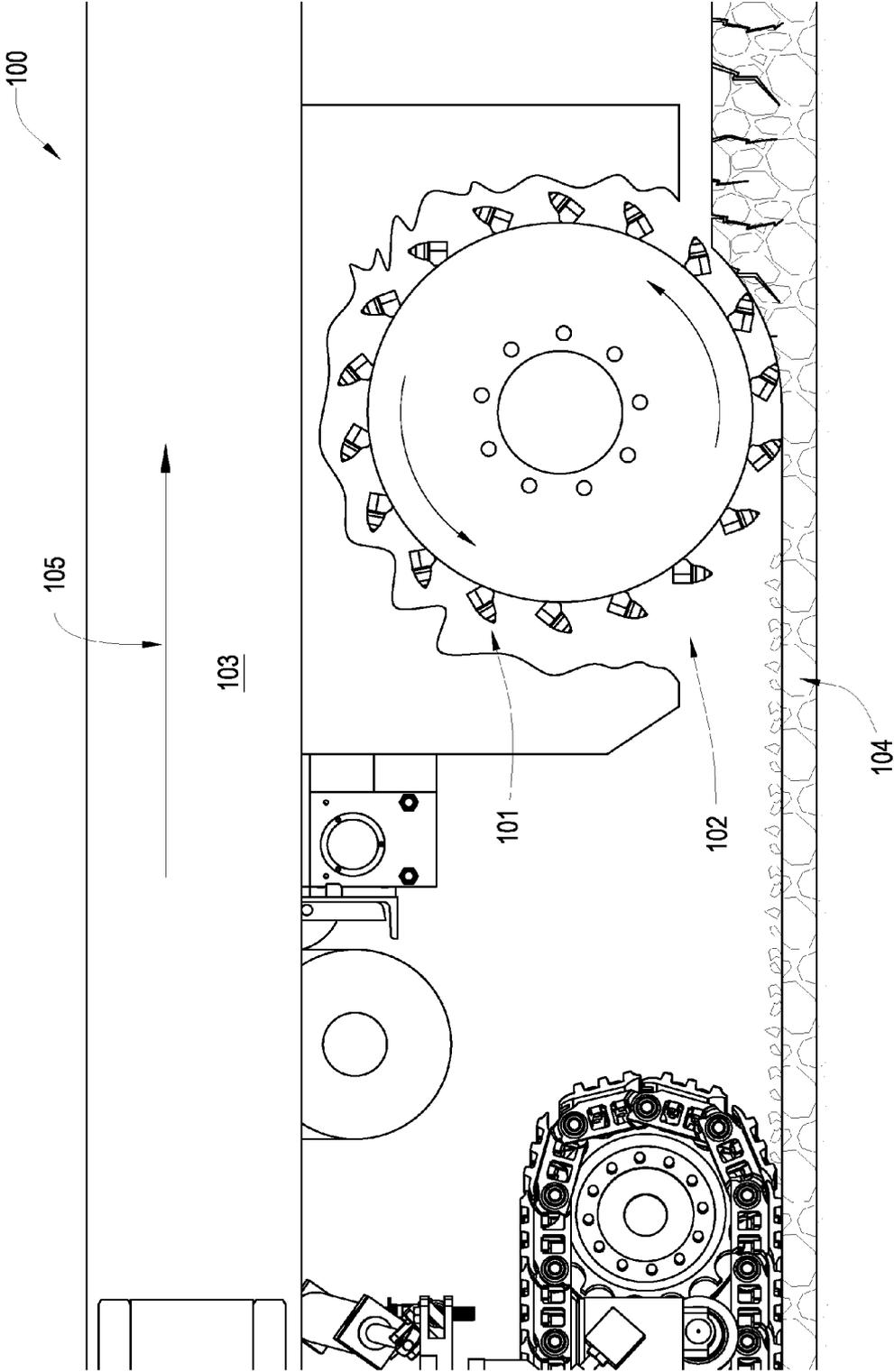


Fig. 1

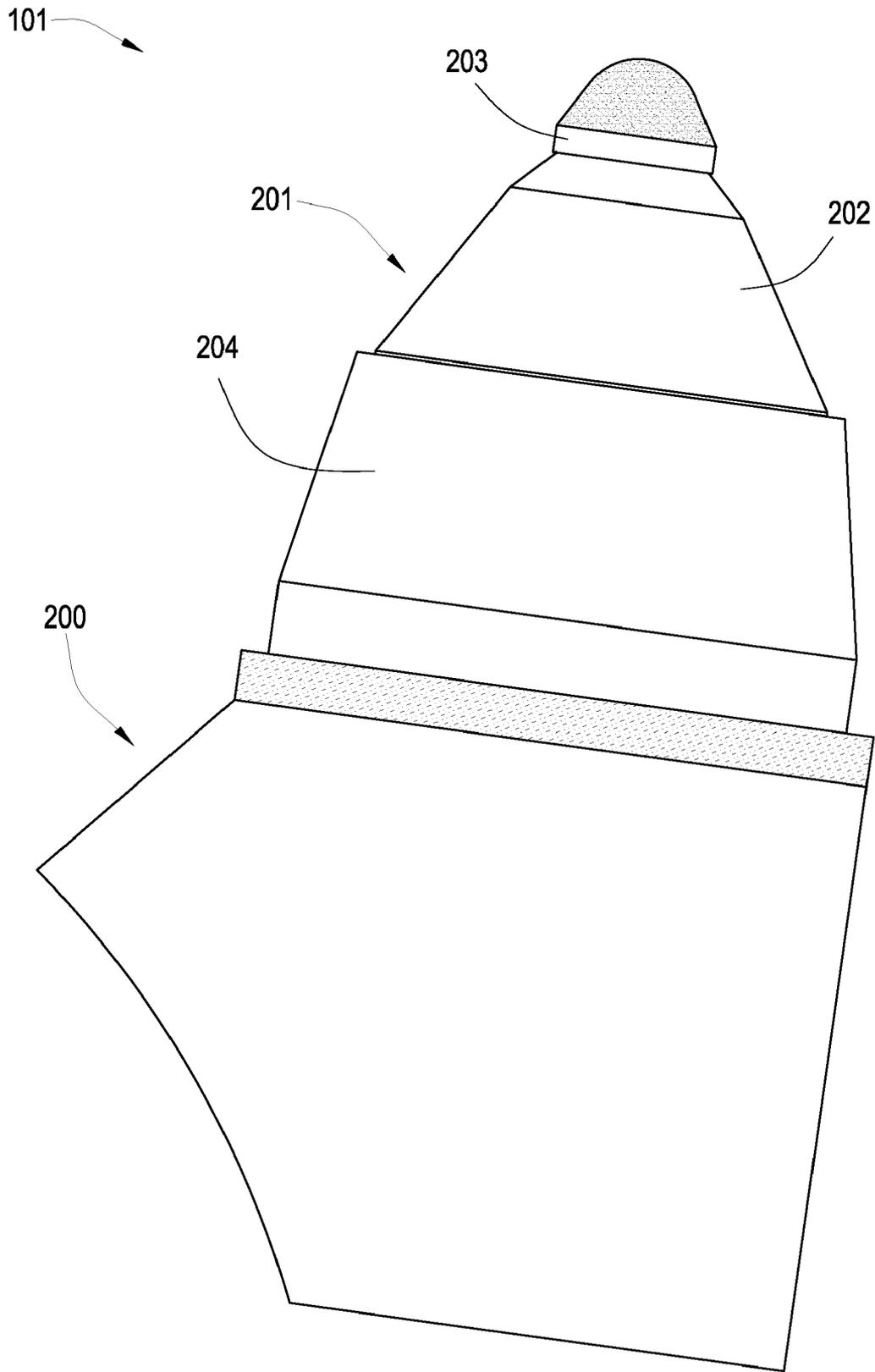


Fig. 2

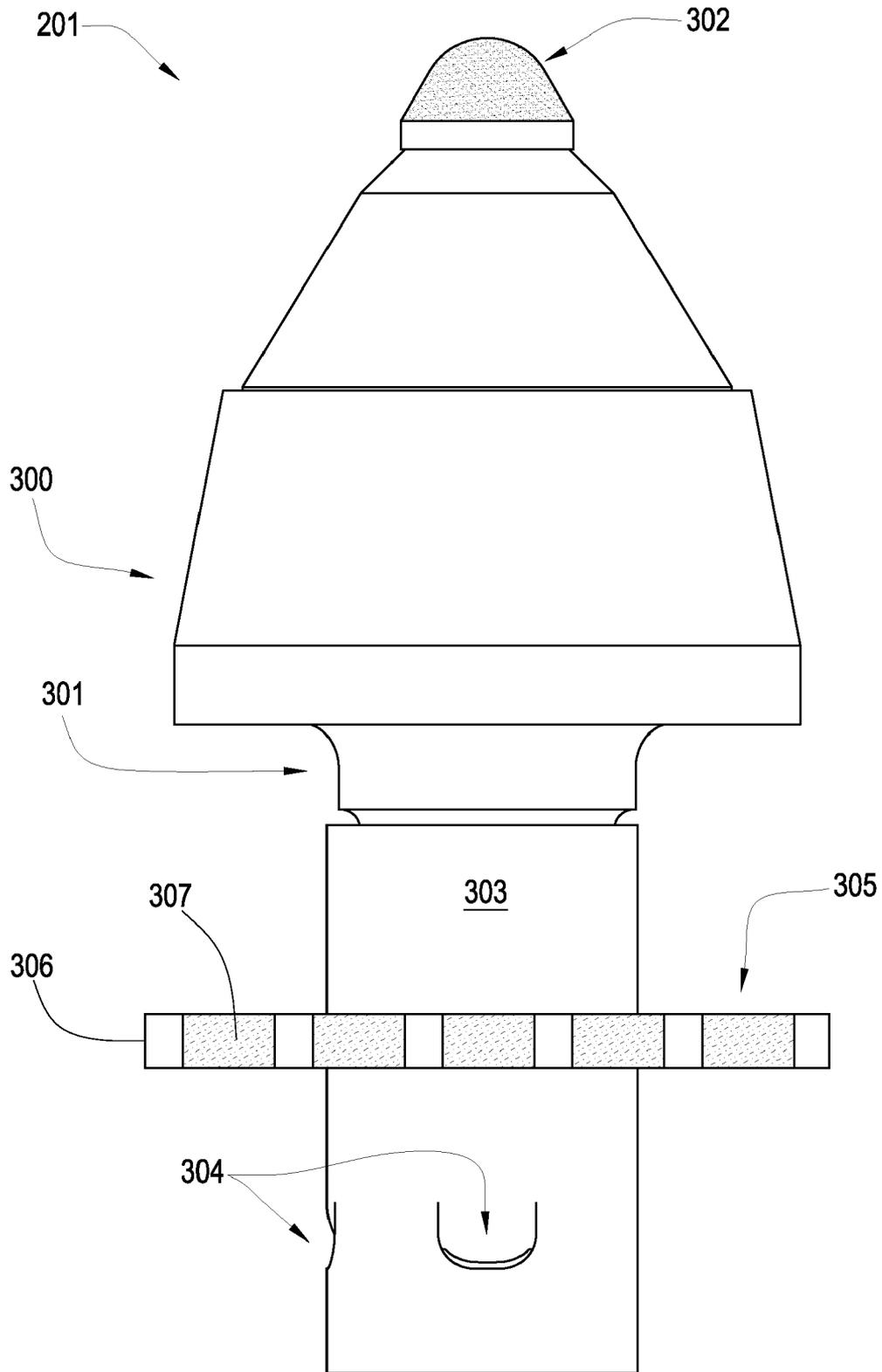


Fig. 3

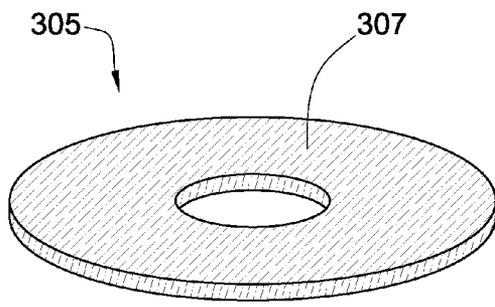


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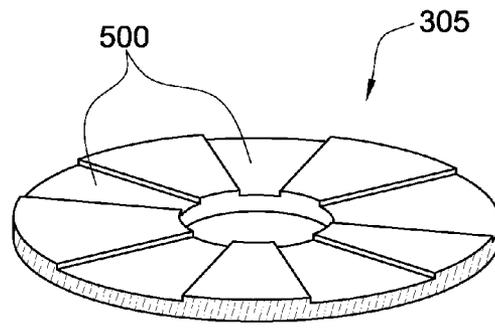


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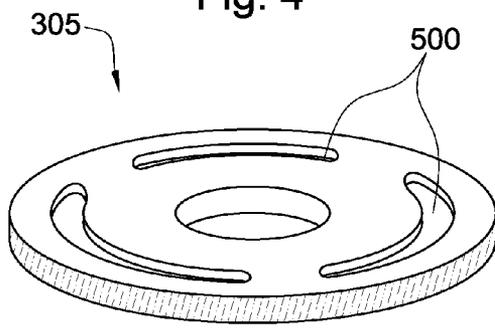


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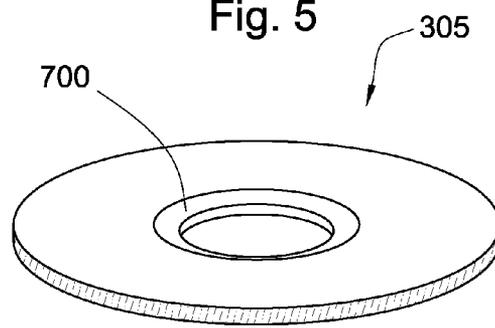


Fig. 7

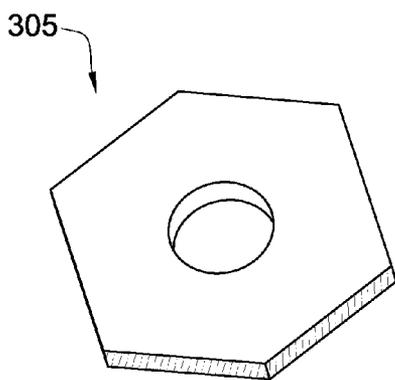


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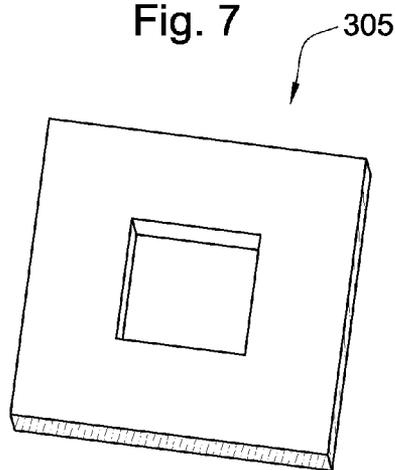


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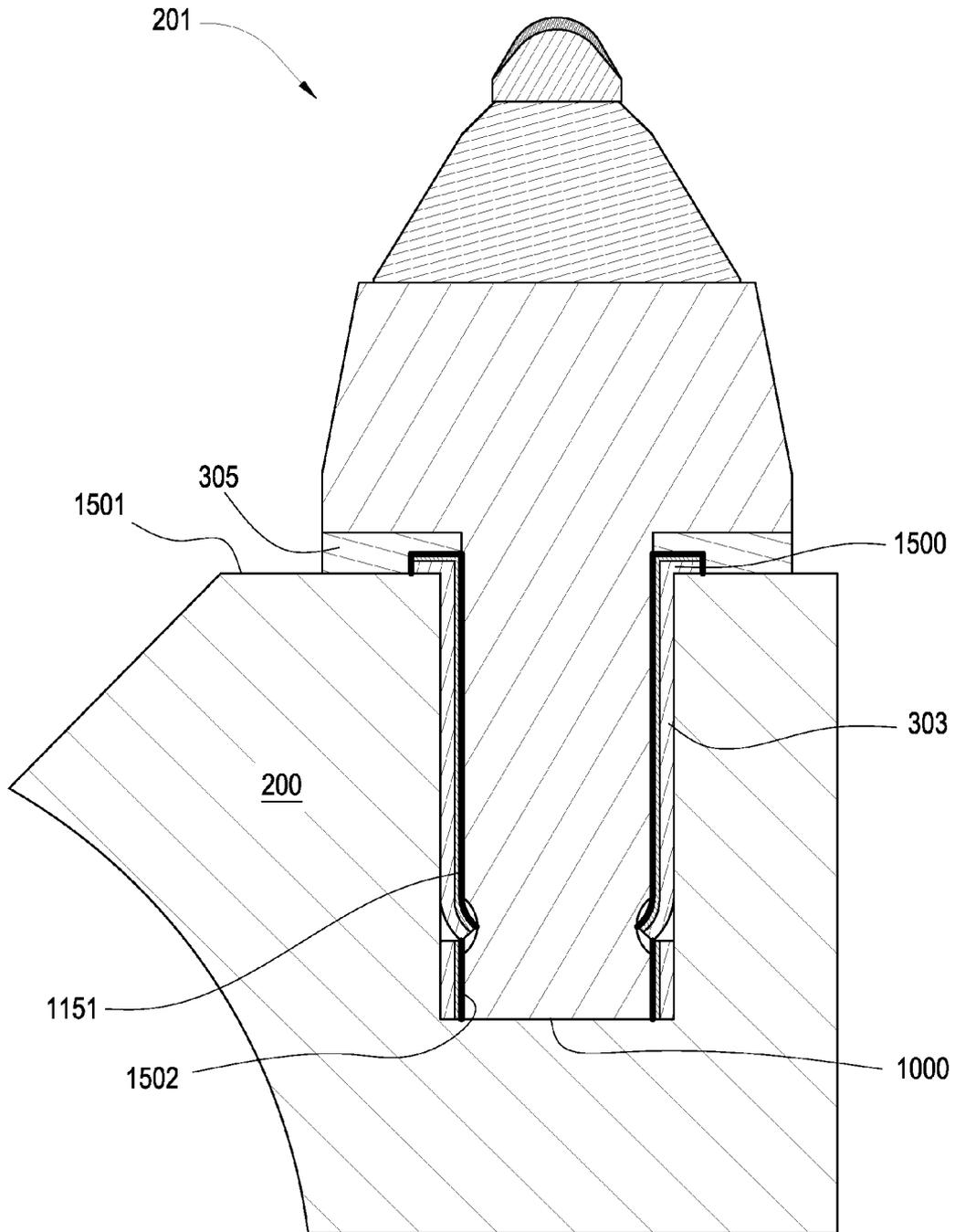


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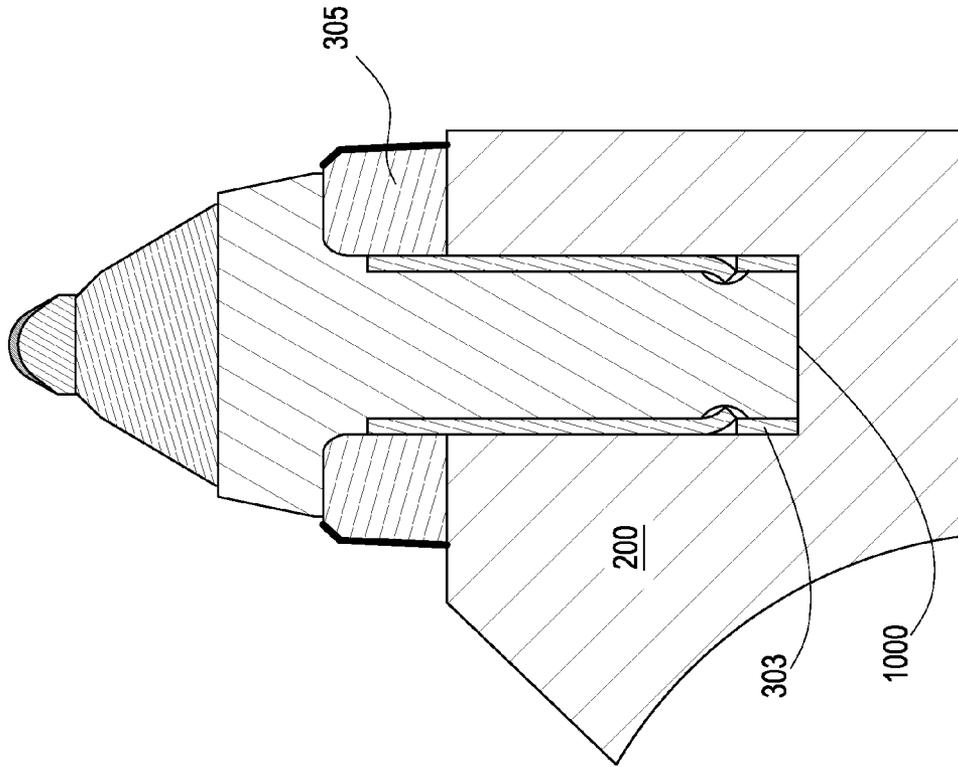


Fig. 11

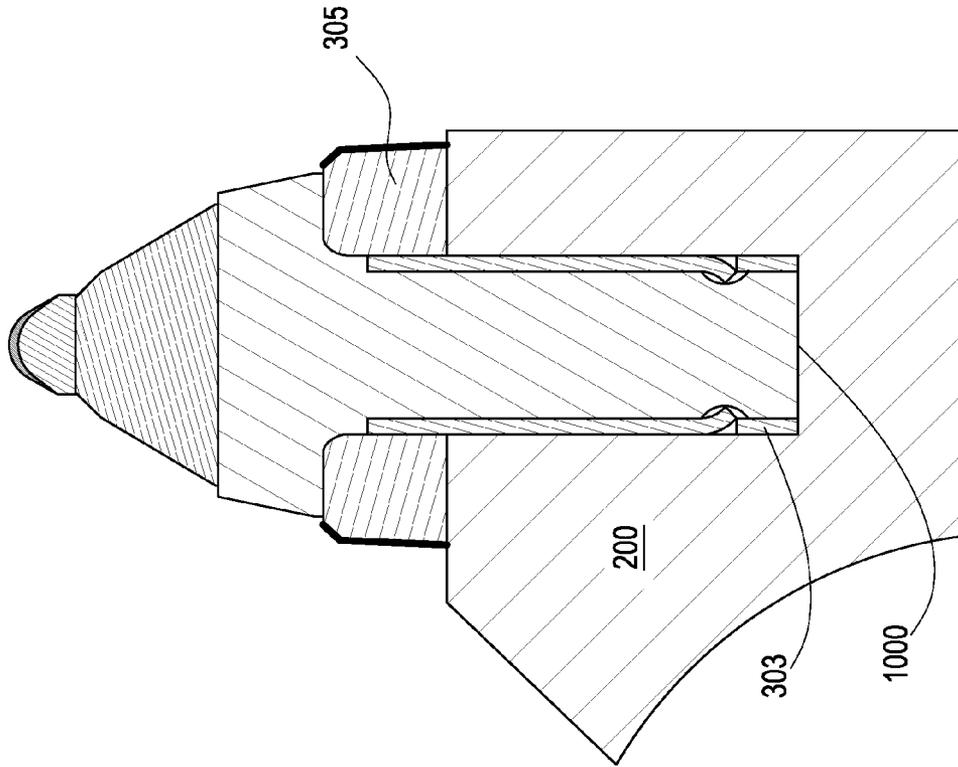


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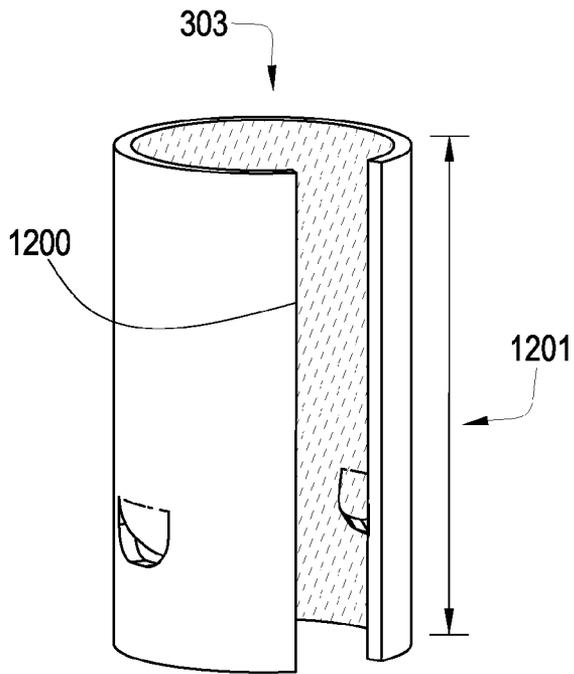


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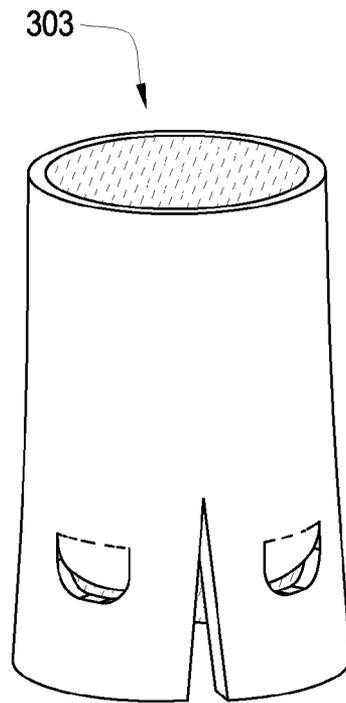


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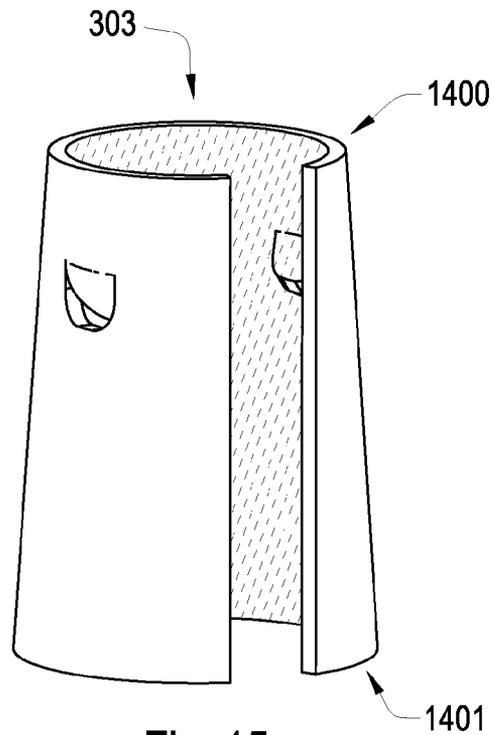


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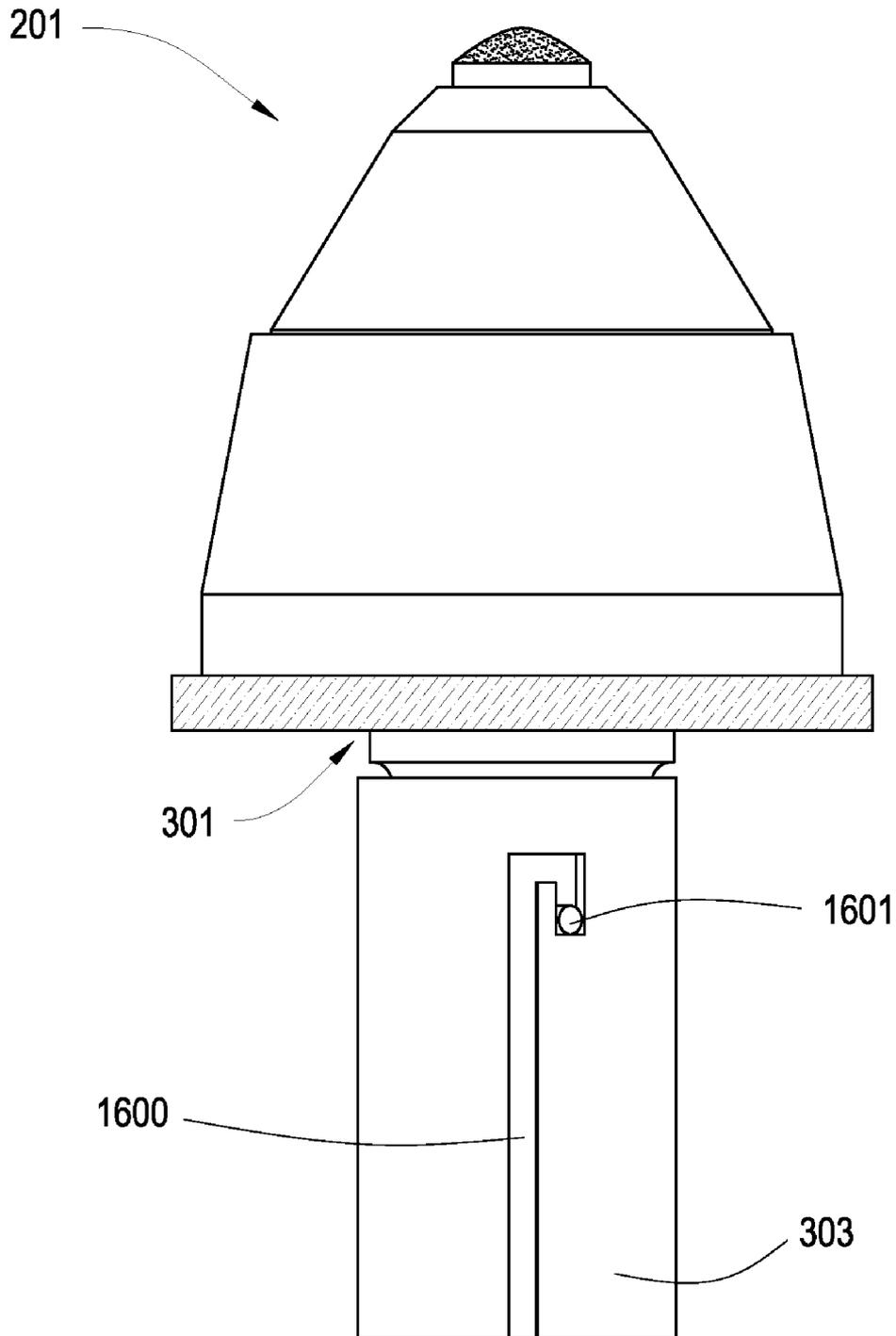


Fig. 16

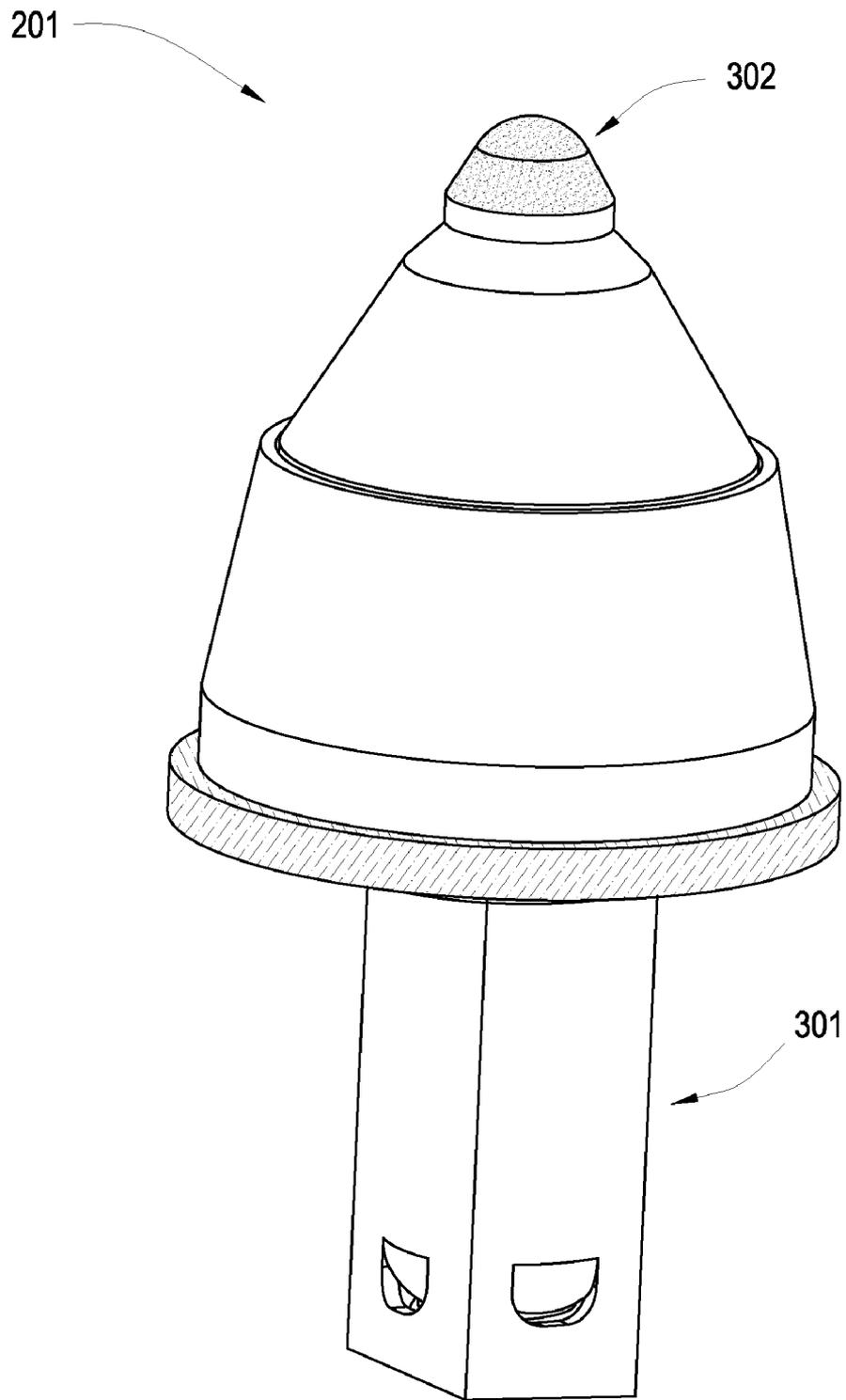


Fig. 17

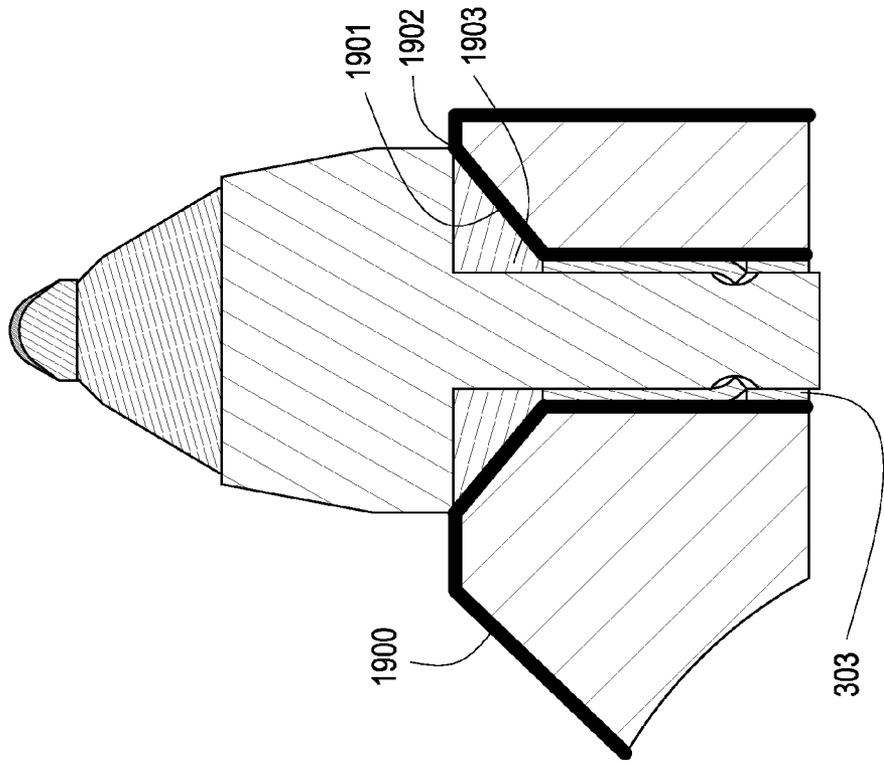


Fig. 19

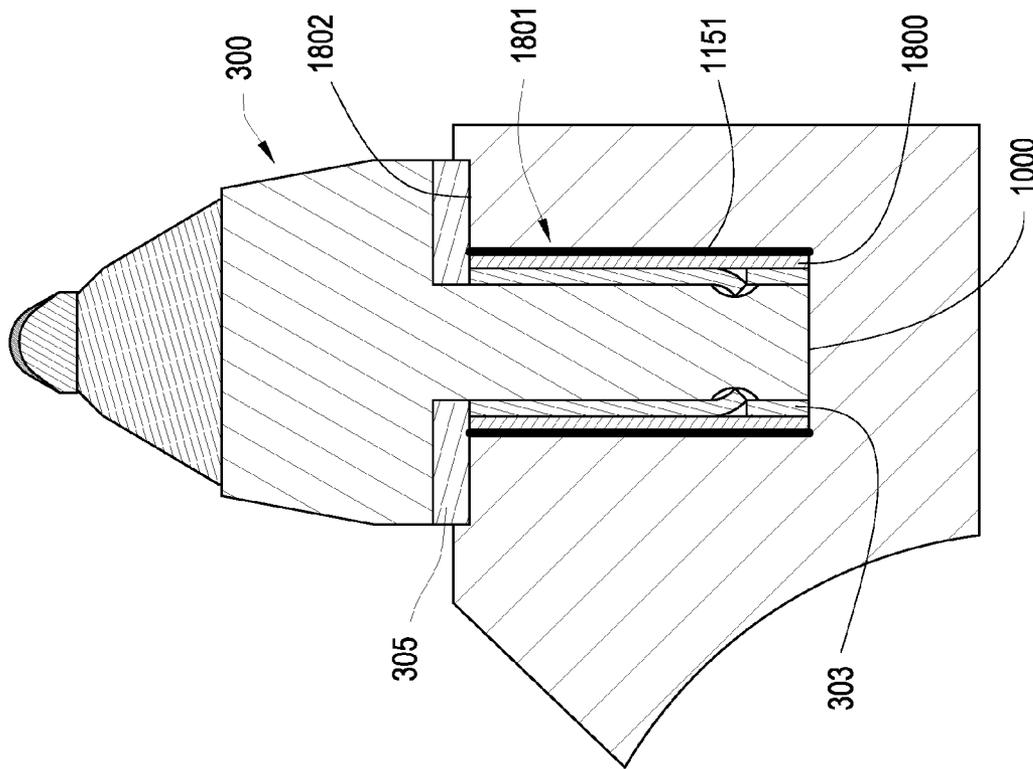


Fig. 18

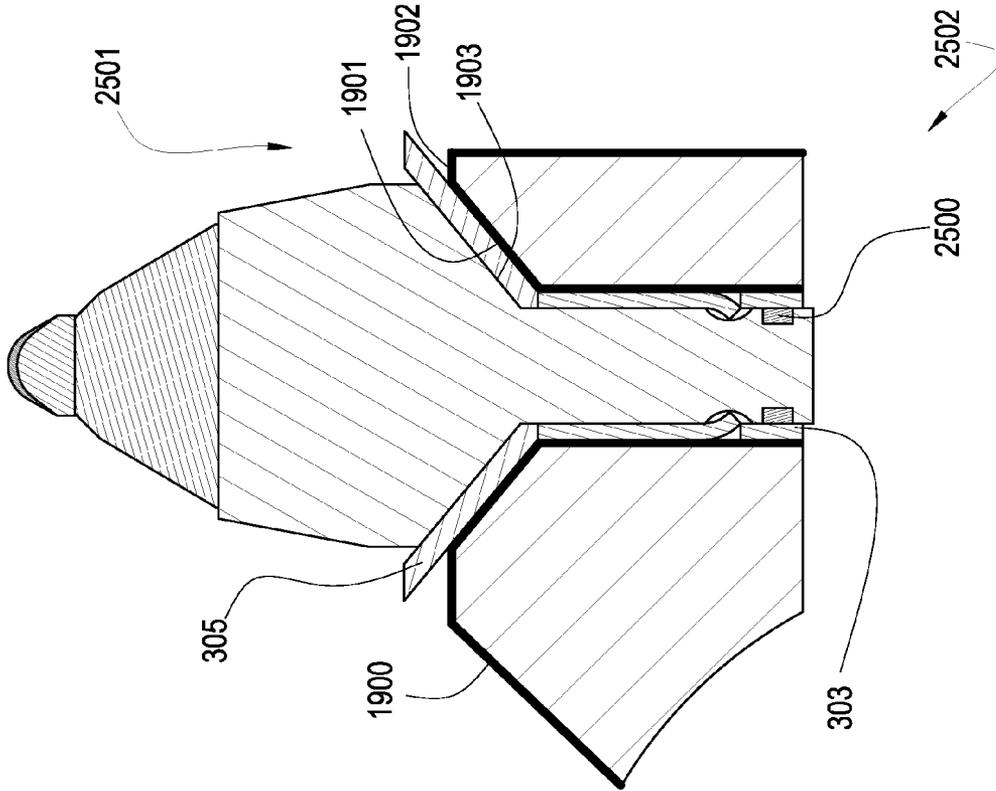


Fig. 21

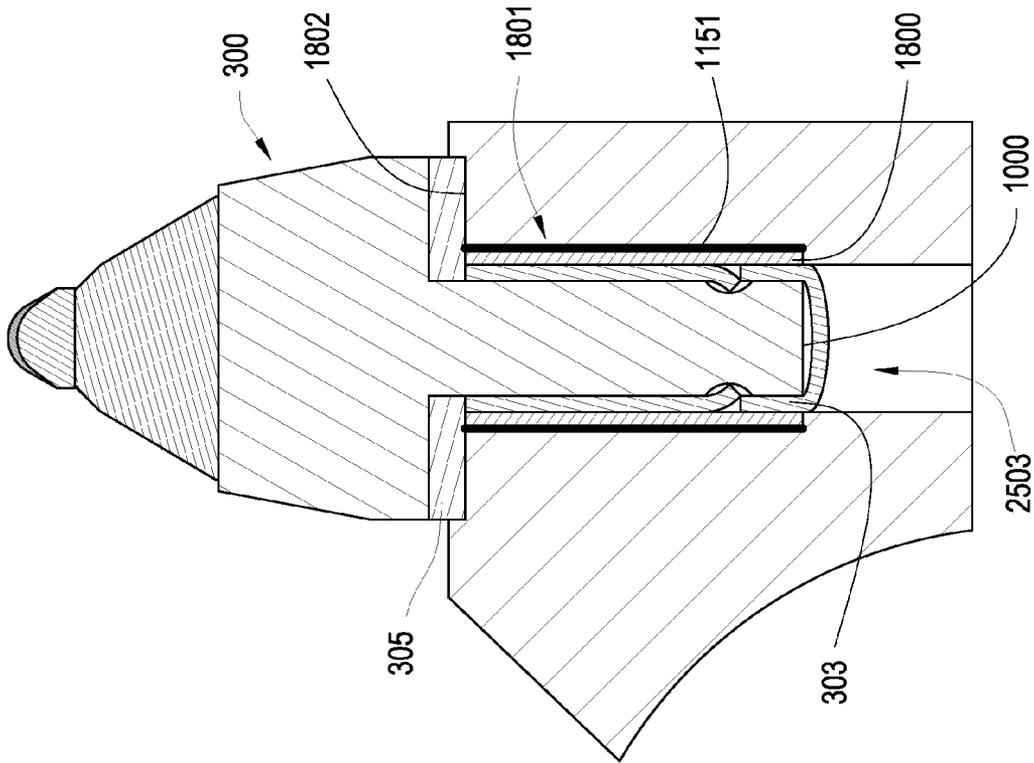


Fig. 20

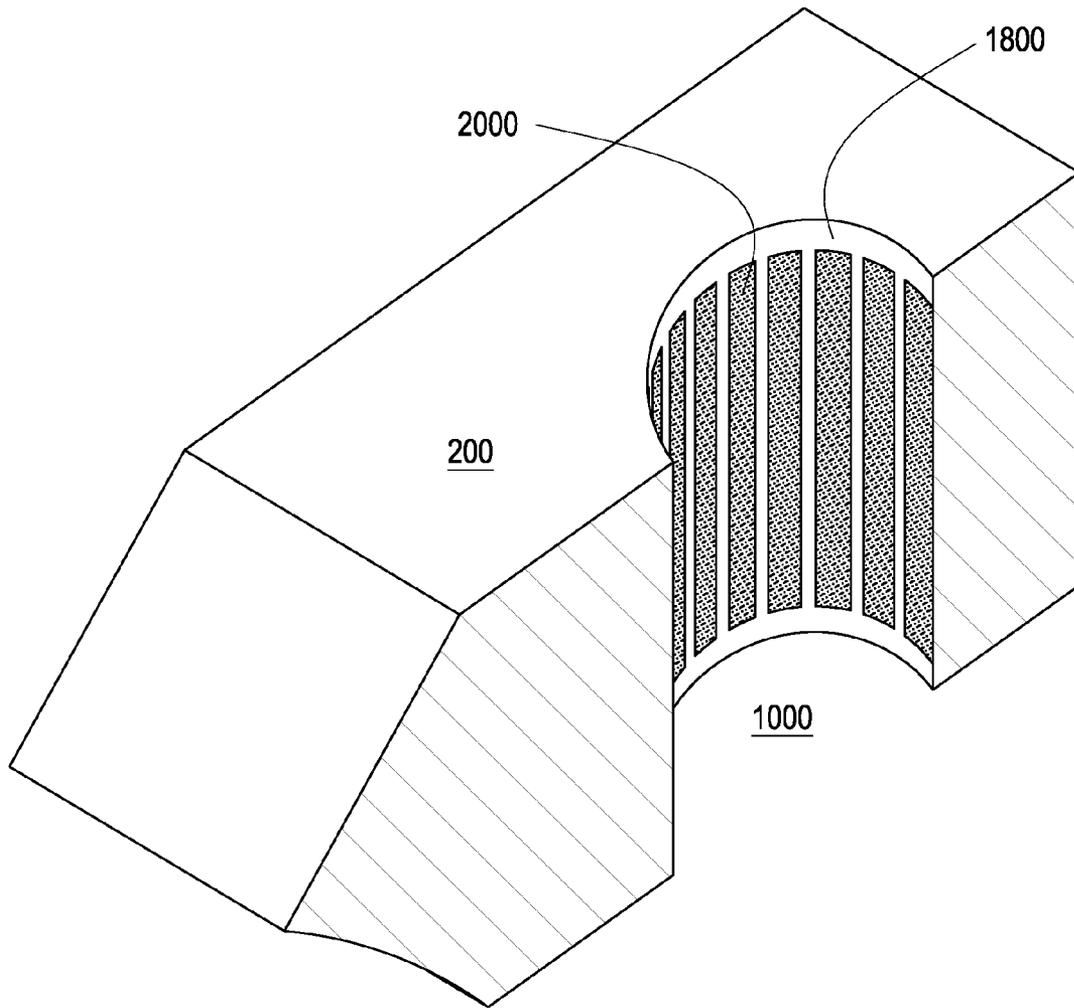


Fig. 22

2100 

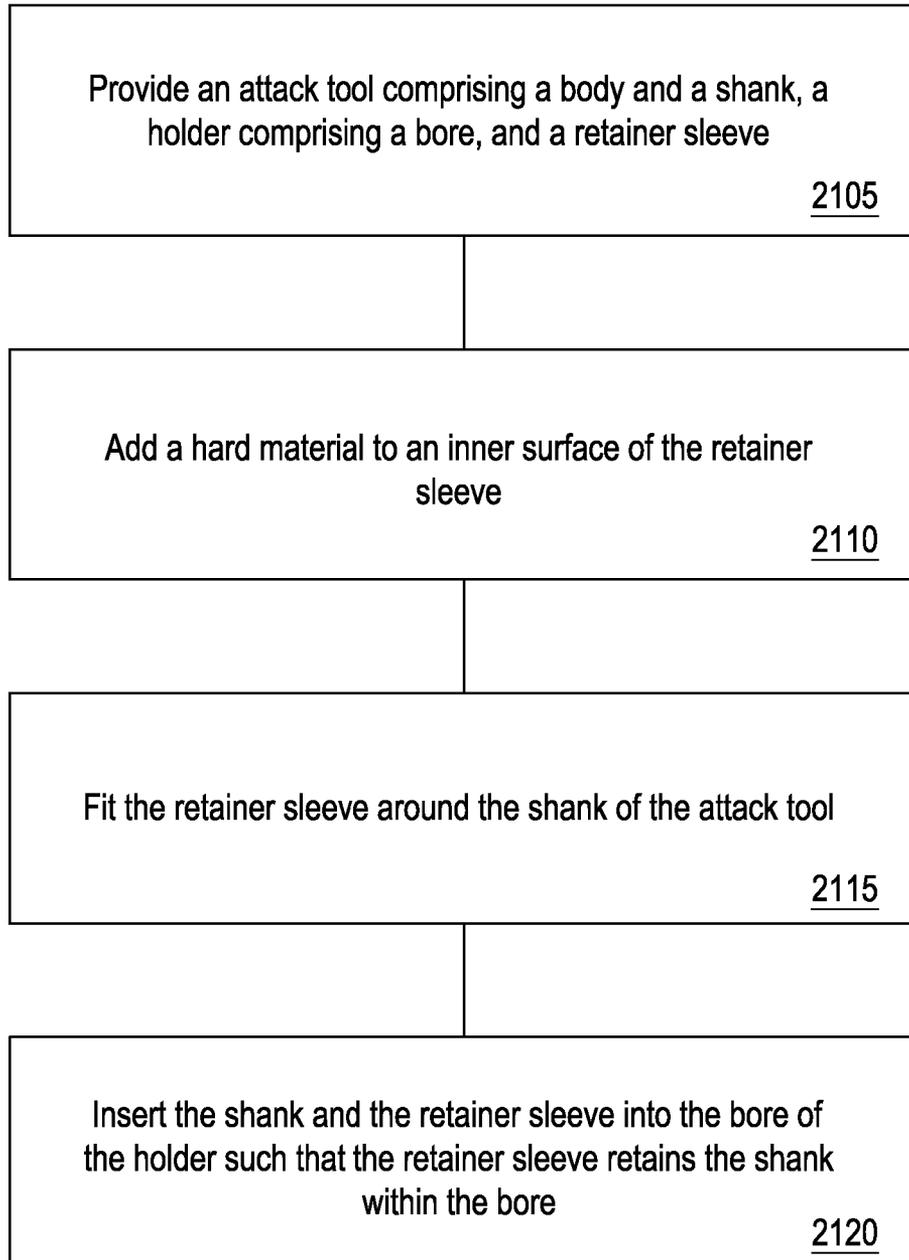


Fig. 23

2200 

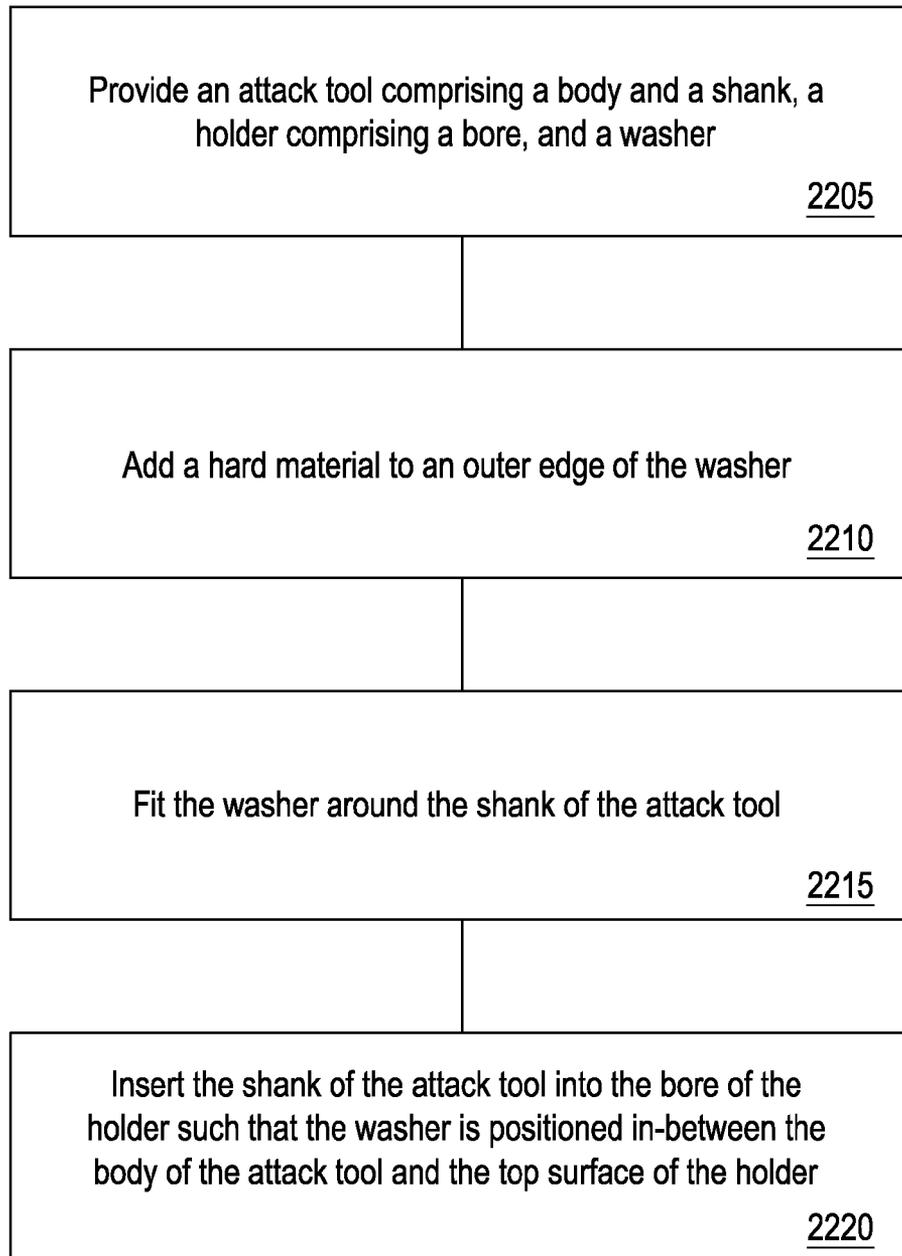


Fig. 24

2300

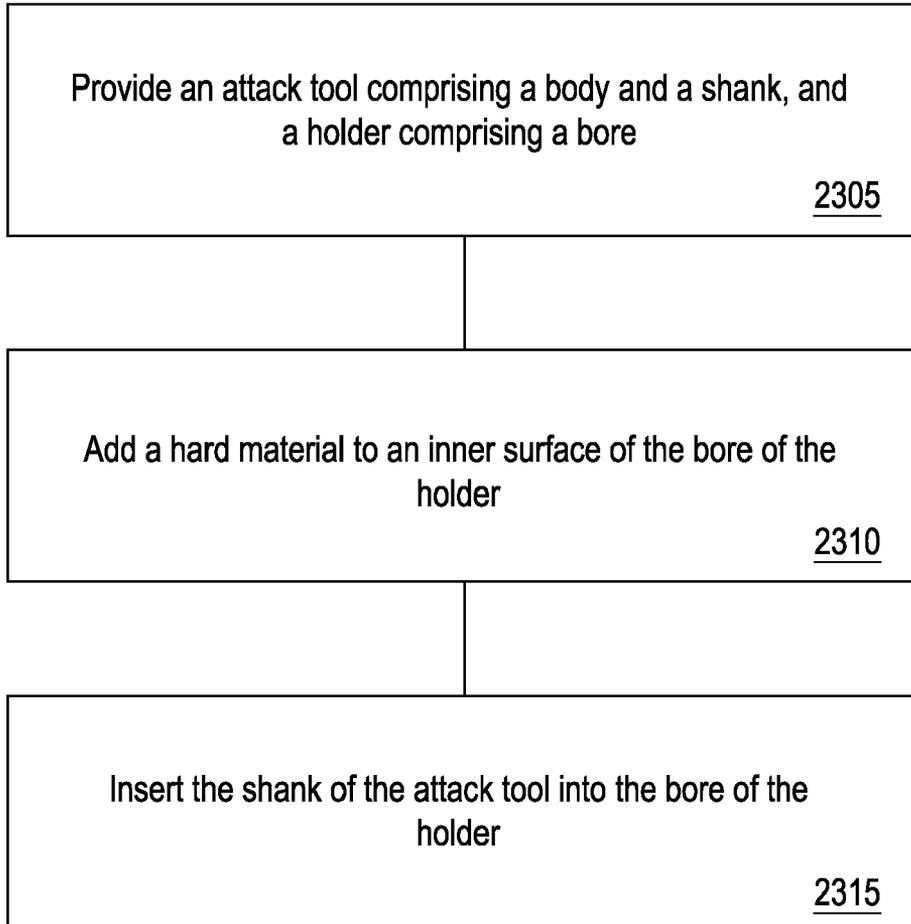


Fig. 25

WASHER FOR A DEGRADATION ASSEMBLY**BACKGROUND OF THE INVENTION**

Efficient degradation of materials is important to a variety of industries including the asphalt, mining, and excavation industries. In the asphalt industry, pavement may be degraded using attack tools, and in the mining industry, attack tools may be used to break minerals and rocks. Attack tools may also be used when excavating large amounts of hard materials. In asphalt recycling, often, a drum supporting an array of attack tools disposed within holders attached, together making up a degradation assembly, may be rotated and moved so that the attack tools engage a paved surface causing the tools and/or holders to wear. Much time is wasted in the asphalt recycling industry due to high wear of the degradation assemblies, which typically have a tungsten carbide tip.

U.S. Pat. No. 6,733,087 to Hall et al., which is herein incorporated by reference for all that it contains, discloses an attack tool for working natural and man-made materials that is made up of one or more segments, including a steel alloy base segment, an intermediate carbide wear protector segment, and a penetrator segment comprising a carbide substrate that is coated with a superhard material. The segments are joined at continuously curved interfacial surfaces that may be interrupted by grooves, ridges, protrusions, and posts. At least a portion of the curved surfaces vary from one another at about their apex in order to accommodate ease of manufacturing and to concentrate the bonding material in the region of greatest variance.

Examples of degradation assemblies from the prior art are disclosed in U.S. Pat. No. 6,824,225 to Stiffler, US Pub. No. 20050173966 to Mouthaan, U.S. Pat. No. 6,692,083 to Latham, U.S. Pat. No. 6,786,557 to Montgomery, Jr., US. Pub. No. 20030230926, U.S. Pat. No. 4,932,723 to Mills, US Pub. No. 20020175555 to Merceir, U.S. Pat. No. 6,854,810 to Montgomery, Jr., U.S. Pat. No. 6,851,758 to Beach, which are all herein incorporated by reference for all they contain.

BRIEF SUMMARY OF THE INVENTION

A degradation assembly having an attack tool with a body and a shank, the body having a wear-resistant tip. The shank is disposed within a bore of a holder secured to a driving mechanism. A washer is positioned in-between the attack tool and the holder and fitted around the shank of the attack tool, wherein an outer edge of the washer has a hardness greater than 58 HRC.

The outer edge of the washer may comprise a material selected from the group consisting of chromium, tungsten, tantalum, niobium, titanium, molybdenum, carbide, natural diamond, polycrystalline diamond, vapor deposited diamond, cubic boron nitride, diamond impregnated carbide, diamond impregnated matrix, silicon bonded diamond, and combinations thereof. The material may comprise a thickness between 0.001 inch and 1 inch. The material of the outer edge may be segmented. The material may comprise a binder concentration of 4 to 35 weight percent. The material may comprise an average grain size between 0.5 μm and 200 μm .

The washer may consist of a hardness greater than 58 HRC. The washer may be made of a material selected from the group consisting of chromium, tungsten, tantalum, niobium, titanium, molybdenum, carbide, natural diamond, polycrystalline diamond, vapor deposited diamond, cubic boron nitride, diamond impregnated carbide, diamond impregnated matrix, silicon bonded diamond, and combinations thereof. The washer may also comprise binder concentration of 4 to 35

weight percent. The washer may be rotationally fixed to the holder. The washer may comprise a diameter to thickness ratio equal to or between 1:1 and 15:1 of a length of the body to a thickness of the washer.

A surface of the washer may also comprise a hardness greater than 58 HRC. The surface may comprise a material selected from the group consisting of chromium, tungsten, tantalum, niobium, titanium, molybdenum, carbide, natural diamond, polycrystalline diamond, vapor deposited diamond, cubic boron nitride, diamond impregnated carbide, diamond impregnated matrix, silicon bonded diamond, and combinations thereof. The surface may be polished. The surface may comprise a plurality of recesses. The surface may be beveled.

The attack tool may be stationary with respect to the holder. The wear-resistant tip of the attack tool may comprise a material with a hardness greater than 4,000 HK.

A method for constructing a degradation assembly comprises providing an attack tool having a body and a shank, a holder having a bore and a top surface, and a washer; adding a hard material to an outer edge of the washer; fitting the washer around the shank of the attack tool; and inserting the shank of the attack tool into the bore of the holder such that the washer is positioned in-between the body of the attack tool and the top surface of the holder. The hard material may be added to the outer edge of the washer by electroplating, electroless plating, cladding, hot dipping, galvanizing, physical vapor deposition, chemical vapor deposition, thermal diffusion, or thermal spraying.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional diagram of an embodiment of an asphalt milling machine.

FIG. 2 is a perspective diagram of an embodiment of a degradation assembly.

FIG. 3 is a perspective diagram of an embodiment of an attack tool.

FIG. 4 is a perspective diagram of an embodiment of a washer.

FIG. 5 is a perspective diagram of another embodiment of a washer.

FIG. 6 is a perspective diagram of another embodiment of a washer.

FIG. 7 is a perspective diagram of another embodiment of a washer.

FIG. 8 is a perspective diagram of another embodiment of a washer.

FIG. 9 is a perspective diagram of another embodiment of a washer.

FIG. 10 is a cross-sectional diagram of another embodiment of a degradation assembly.

FIG. 11 is a cross-sectional diagram of another embodiment of a degradation assembly.

FIG. 12 is a perspective diagram of an embodiment of a retainer sleeve.

FIG. 13 is a perspective diagram of another embodiment of a retainer sleeve.

FIG. 14 is a perspective diagram of another embodiment of a retainer sleeve.

FIG. 15 is a cross-sectional diagram of another embodiment of a degradation assembly.

FIG. 16 is a perspective diagram of another embodiment of an attack tool.

FIG. 17 is a perspective diagram of another embodiment of an attack tool.

FIG. 18 is a cross-sectional diagram of another embodiment of a degradation assembly.

FIG. 19 is a cross-sectional diagram of another embodiment of a degradation assembly.

FIG. 20 is a cross-sectional diagram of another embodiment of a degradation assembly.

FIG. 21 is a cross-sectional diagram of another embodiment of a degradation assembly.

FIG. 22 is a cross-sectional diagram of an embodiment of a holder.

FIG. 23 is a diagram of a method for manufacturing a degradation assembly.

FIG. 24 is a diagram of another method for manufacturing a degradation assembly.

FIG. 25 is a diagram of another method for manufacturing a degradation assembly.

DETAILED DESCRIPTION OF THE INVENTION AND THE PREFERRED EMBODIMENT

According to one aspect of the invention and referring to FIG. 1, an asphalt milling machine 100 may comprise a driving mechanism 102 attached to a motor vehicle 103. A plurality of degradation assemblies 101 may be secured to the driving mechanism 102. The driving mechanism 102 may be a rotating drum, a chain, a rotor, or combinations thereof. The asphalt milling machine 100 may degrade a paved surface 104 of a road, sidewalk, or parking lot prior to applying new pavement. The driving mechanism 102 may rotate such that the degradation assemblies 101 engage the paved surface 104 as the motor vehicle 103 moves in a direction indicated by the arrow 105. In other embodiments of the invention, the driving mechanism 102 may be attached to a mining vehicle or other drilling machine.

Referring to FIGS. 2 and 3, the degradation assembly 101 comprises a holder 200 and an attack tool 201. The attack tool 201 comprises a body 300 and a shank 301, wherein the shank 301 is disposed within a bore of the holder 200. The body 300 comprises a first and a second carbide segment 202, 203 and a steel portion 204. The steel portion 204 may comprise a hardness of 35 to 55 HRC. The first carbide segment 202 may be brazed to the steel portion 204. The second carbide segment 203 may be brazed to the first carbide segment 202 and also comprise a wear-resistant tip 302 with a material having a hardness greater than 4,000 HK according to the Knoop Hardness scale. In some embodiments, the wear-resistant tip 302 may be bonded directly to the first segment 202. It may be desirable to have the first and second carbide segments 202, 203 in embodiments where the wear-resistant tip 302 comprises a ceramic formed in a high temperature high pressure press, so that the second carbide segment 203 may be bonded to the ceramic in the press. The wear-resistant tip 302 may comprise a superhard material made of polycrystalline diamond, vapor-deposited diamond, natural diamond, cubic boron nitride, infiltrated diamond, layered diamond, diamond impregnated carbide, diamond impregnated matrix, silicon bonded diamond, or combinations thereof. The superhard material may be 1 to 20000 microns thick. In embodiments, where the superhard material is a ceramic, the material may comprise a region (preferably near its surface) that is free of binder material. The average grain size of a superhard ceramic may be 0.02 to 100 microns in size. Infiltrated diamond is typical made by sintering the superhard material adjacent a cemented metal carbide and allowing a metal (such as cobalt) to infiltrate into the superhard material. The superhard material may be a synthetic diamond comprising a binder concentration of 1 to 35 weight percent.

The degradation assembly 101 may comprise a retainer sleeve 303 disposed around the shank 301 of the attack tool 201. The sleeve 303 may be indented such that protrusion of the indented areas 304 complement a radially recessed portion of the shank, allowing the sleeve 303 to grip the shank 301 when under compression, while still allowing the shank to rotate. The sleeve 303 may also be a spring so that when the shank 301 and sleeve 303 are inserted into the bore of the holder 200, the sleeve 303 expands to fit tightly into the bore while maintaining a grip on the shank 301. The shank may also be made of steel, or it may comprise a wear-resistant material comprising a hardness greater than 58 HRC.

The degradation assembly may also comprise a washer 305 positioned in-between the body 300 of the attack tool 201 and the holder 200 and fitted around the shank 301 of the attack tool 201. The washer 305 may provide protection for the holder 200 against degraded materials or against any rotation of the body 301 of the attack tool 201. The washer 305 may be made of a ceramic comprising a binder concentration of 4 to 35 weight percent. It is believed that a higher binder weight concentration may allow the washer 305 to absorb more pressure or shock received by the body 300 of the attack tool 201. A preferred binder is cobalt. The washer may consist of a hardness greater than 58 HRC.

The washer 305 may also comprise an outer edge 306 with a material 307 of hardness greater than 58 HRC, according to the Rockwell Hardness C scale. The material 307 may comprise chromium, tungsten, tantalum, niobium, titanium, molybdenum, carbide, natural diamond, polycrystalline diamond, vapor deposited diamond, cubic boron nitride, diamond impregnated carbide, diamond impregnated matrix, silicon bonded diamond, or combinations thereof. The material 307 may be continuous on the outer edge, as in the embodiment of FIG. 2, or it may be segmented, as in the embodiment of FIG. 3. The material 307 may be added to the washer by electroplating, electroless plating, cladding, hot dipping, galvanizing, physical vapor deposition, chemical vapor deposition, thermal diffusion, or thermal spraying. The material 307 may also comprise an average grain size between 0.5 μm and 200 μm . The material 307 on the outer edge 306 of the washer 305 may comprise a thickness between 0.001 inch to 1 inch.

FIGS. 4 through 9 are perspective diagrams of separate embodiments of washers 305 that may be used with the present invention. Referring to FIG. 4, an entire surface of the washer 305 may be covered with a material 307 of hardness greater than 58 HRC, or the washer 305 may be entirely made of the material 307. Referring to FIGS. 5 and 6, a surface of the washer 305 may comprise a plurality of recesses 500 or patterns. Referring now to FIG. 7, the washer 305 may comprise a beveled surface 700. The washer 305 may also comprise a plurality of layers, wherein an intermediate layer 1151 may be used to improve the strength or the bond of the material 307 bonded to the outer edge 306 of the washer 305. This may be advantageous in embodiments where a material 307 such as diamond is bonded to a steel surface. Since diamond does not bond well directly to steel, a layer 1151 of different material such as tungsten carbide may be bonded to the steel, and the diamond may then be bonded to the tungsten carbide. The washer 305 may comprise any shape, as in FIGS. 8 and 9, and may be adapted to fit around shanks 301 of different sizes or shapes.

Referring to FIGS. 10 and 11, the washer 305 may comprise any thickness such that the body length-to-washer thickness ratio is between and including 1:1 to 15:1. A thick washer 305 may allow for more impact absorption. The washer 305 may also be polished to allow for easier, less abrasive rotation

in embodiments wherein the attack tool **201** is allowed to rotate within the bore **1000** of the holder **200**. The outer edge **306** of the washer **305** may be flush with an outer edge **1150** of the body **300** of the attack tool **201**. The outer edge **306** of the washer **305** may also comprise a larger diameter than the outer edge **1150** of the body of the attack tool, or it may comprise a smaller diameter. A retainer sleeve **303** may be disposed entirely within the bore **1000** of the holder **200**, as in the embodiment of FIG. **10**, or it may extend beyond an opening of the bore, as in the embodiment of FIG. **11**.

Referring to FIG. **12**, the retainer sleeve **303** may comprise an inner surface **1502** with a hardness greater than 58 HRC. In some embodiments, any surface of the sleeve **303** may comprise a hardness greater than 58 HRC. The hardness may be achieved by bonding a material **307** comprising chromium, tungsten, tantalum, niobium, titanium, molybdenum, carbide, natural diamond, polycrystalline diamond, vapor deposited diamond, cubic boron nitride, aluminum oxide, zircon, silicon, whisker reinforced ceramics, TiN, AlNi, AlTiNi, TiAlN, CrN/CrC/(Mo, W)S₂, TiN/TiCN, AlTiN/MoS₂, TiAlN, ZrN, diamond impregnated carbide, diamond impregnated matrix, silicon bonded diamond, or combinations thereof to any of the surfaces of the sleeve.

The sleeve **303** may comprise a lip **1500** proximate an outer edge of the sleeve. The lip **1500** may extend beyond the opening of the bore **1000** of the holder **200**. The washer **305** may be recessed such that the washer **305** fits over the lip **1500**, and so that the lip **1500** and the washer **305** are both flush against a top surface **1501** of the holder **200**. An intermediate layer **1151** may be used to improve the strength or the bond of the material **307** bonded to the surface **1502** of the sleeve **303**.

The material **307** may line the sleeve **305** at any part which may come in contact with the washer **305**, such as along upper or outer edges of the lip **1500**. The material **307** may be added to the sleeve by electroplating, electroless plating, cladding, hot dipping, galvanizing, thermal spraying chemical vapor deposition, thermal diffusion or physical vapor deposition. Material **307** may also be added to an outer surface of the shank **301** by the same methods. In some embodiments, the shank **301** and the sleeve **303** may comprise the same composition of material **307**, or they may comprise different compositions of material **307**. Both surfaces may be polished.

FIGS. **13** through **15** are perspective diagrams of separate embodiments of retainer sleeves **303**. The retainer sleeve **303** may comprise a dividing slit **1200** which spans an axial length **1201**, as in FIG. **13**. This embodiment may be advantageous in allowing the sleeve **303** to expand within the bore **1000**, establishing a compressive connection between the bore **1000** and the sleeve **303**. The slit **1200** may also span only a portion of the axial length **1200** of the sleeve **303**, as in FIG. **14**. This embodiment may allow the sleeve **303** to maintain a strong grip on the shank **301** of the attack tool **201** and the holder **200**. The embodiment of FIG. **15** comprises a different diameter at a first end **1400** than at a second end **1401** of the sleeve **303**. This embodiment may provide a stronger compressive connection between the bore **1000** and the sleeve **303**. The retainer sleeve may comprise a thickness between and including 0.01 inches to 0.5 inches.

In the embodiment of FIG. **16**, the retainer sleeve **303** comprises a guide slot **1600**, wherein a guide pin **1601** attached to the shank **301** of the attack tool **201** may fit within the guide slot **1600**. The guide pin **1601** may be spring-loaded and the bore **1000** may comprise a receiving slot such that when the shank **301** and the sleeve **303** are inserted into the bore **1000** of the holder **200**, the pin **1601** is not allowed to move vertically within the guide slot **1600**, keeping the attack

tool **201** stationary with respect to the sleeve **303**. The attack tool **201** may also be stationary with respect to the holder **200**.

Referring to FIG. **17**, the shank **301** may also comprise any shape, size, or length and be adapted to fit into a bore **1000** of any shape, size, or length. This may be advantageous when using attack tools **201** that are designed to be rotationally stationary during operation of the driving mechanism **102**. Degrading a hard formation may not cause significant wear to the wear-resistant tip **302**, allowing the attack tool **201** to be stationary with respect to the holder **200** without altering the effectiveness of the attack tool **201**.

In the embodiment of FIG. **18**, the bore **1000** of the holder **200** may comprise an inner surface **1800** comprising a material **307** with a hardness greater than 58 HRC. The material **307** of the inner surface **1800** of the bore **1000** may be selected from the group consisting of chromium, tungsten, tantalum, niobium, titanium, molybdenum, carbide, natural diamond, polycrystalline diamond, vapor deposited diamond, cubic boron nitride, aluminum oxide, zircon, silicon, whisker reinforced ceramics, TiN, AlNi, AlTiNi, TiAlN, CrN/CrC/(Mo, W)S₂, TiN/TiCN, AlTiN/MoS₂, TiAlN, ZrN, diamond impregnated carbide, diamond impregnated matrix, silicon bonded diamond, and combinations thereof. The material **307** of the inner surface **1800** may comprise a thickness between 0.001 inches and 0.5 inches.

The inner surface **1800** of the bore may be polished, causing less friction and subsequent wear on the retainer sleeve **303** while also creating a stronger hold with the retainer sleeve **303**. The inner surface **1800** of the bore **1000** may also comprise a polycrystalline ceramic with a binder concentration of 4 to 35 weight percent. The binder may comprise elements such as cobalt which strengthens the hard material and allow for better absorption of impact forces. The inner surface **1800** of the bore **1000** may also comprise a plurality of layers bonded together. The layers may comprise different compositions of elements, which may provide protection from various forces such as abrasion, impact, or shearing. An intermediate layer **1151** may be used to improve the strength or the bond of the wear-resistant material **307** bonded to the inner surface of the bore of the holder.

The material **307** of the inner surface **1800** may also be a removable component such as an additional sleeve **1801**. The sleeve may be compressively bonded to the inner surface **1800** of the bore **1000** and may also be adapted to fit around the retainer sleeve **303** such that both the sleeve **1801** of the inner surface **1800** and the retainer sleeve **303** fit inside the bore **1000** of the holder **200** and around the shank **301** of the attack tool **201**.

The holder **200** may also comprise a recessed portion **1802** wherein an opening of the bore **1000** is disposed within the recessed portion **1802**. All or part of the washer **305** or part of the body **300** of the attack tool **201** may be disposed within the recessed portion **1802**. The recessed portion **1802** may be adapted to receive any shape of washer **305**. The washer **305** may be rotationally fixed to the holder **200** in some embodiments by a slot, a tab, or other means.

In the embodiment of FIG. **19**, the holder **200** comprises a material **307** on an outer surface **1900** in addition to the material **307** of the inner surface **1800** of the bore **1000**. This may provide protection against degraded elements that impact the outer surface **1900** while the driving mechanism **102** is in operation. The material may prevent significant wear on the outer surface **1900** of the holder **200**, allowing for a better life-span of the holder **200**. The holder **200** may also comprise a beveled opening **1901**. The beveled opening **1901** may receive a washer **305** comprising different inner and

outer thicknesses **1901, 1902**. The bore **1000** may also comprise a square opening adapted to receive a square shank **301**.

Now referring to FIGS. **20** and **21**, there may be a seal **2500** disposed between the inner surface of the bore and the sleeve or the seal may be disposed between the sleeve and the shank. ⁵ Either seal may be placed adjacent a forward end **2501** or a rearward end **2502** of the sleeve. The seal **2500** may provide the benefit of preventing debris from getting between the sleeve and the holder or between the sleeve and the shank. ¹⁰ In some embodiments, the washer **305** may be angled such that it seals the debris from entering between the sleeve and the holder and/or the sleeve and shank. In other embodiments, the rearward end of the sleeve may comprise a closed end **2503**. ¹⁵ The seals **2500** may comprises a plastic plug, oily cloth, felt, metal seals, gasket, or combinations thereof.

Referring to FIG. **22**, the material **307** of the inner surface **1800** of the bore **1000** may be segmented. Segmented material **2000** may be positioned such that they may direct any rotation of the attack tool **201**. Segmented material **2000** may be more cost effective than a continuous layer of material **307**, while providing adequate protection from damaging forces. ²⁰ The material **307** may be added to the inner or outer surfaces **1800, 1900** of the holder **200** by electroplating, electroless plating, cladding, hot dipping, galvanizing, or thermal spraying. The material may be disposed within recesses formed in the bore of the holder. A material may be flush with the bore of the holder or it may extend into the bore.

Referring to FIG. **23**, a method **2100** for manufacturing a degradation assembly comprises providing **2105** an attack tool comprising a body and a shank, a holder comprising a bore, and a retainer sleeve; adding **2110** a hard material to an inner surface of the retainer sleeve; fitting **2115** the retainer sleeve around the shank of the attack tool; and inserting **2120** the shank and the retainer sleeve into the bore of the holder such that the retainer sleeve retains the shank within the bore. ³⁵

Referring to FIG. **24**, a method **2200** for manufacturing a degradation assembly comprises providing **2205** an attack tool comprising a body and a shank, a holder comprising a bore, and a washer; adding **2210** a hard material to an outer edge of the washer; fitting **2215** the washer around the shank of the attack tool; and inserting **2220** the shank of the attack tool into the bore of the holder such that the washer is positioned in-between the body of the attack tool and the top surface of the holder. ⁴⁰

Referring to FIG. **25**, a method **2300** for manufacturing a degradation assembly comprises providing **2305** an attack tool comprising a body and a shank, and a holder comprising a bore; adding **2310** a hard material to an inner surface of the bore of the holder; and inserting **2315** the shank of the attack tool into the bore of the holder. ⁴⁵

Whereas the present invention has been described in particular relation to the drawings attached hereto, it should be understood that other and further modifications apart from those shown or suggested herein, may be made within the scope and spirit of the present invention. ⁵⁰

What is claimed is:

1. A degradation assembly comprising:
 - an attack tool comprising a body and a shank, the body comprising a wear resistant tip;
 - the shank being disposed within a bore of a holder secured to a driving mechanism; and
 - a steel washer positioned in-between the attack tool and the holder and fitted around the shank of the attack tool, wherein one or both of an inner and outer surface of the steel washer is coated with tungsten carbide comprising a binder;
 - wherein the washer comprises a plurality of coatings, wherein the washer of comprises a coating of tungsten carbide intermediate the steel of the washer and a layer of diamond.
2. The degradation assembly of claim 1, wherein the tungsten carbide comprises a thickness between 0.001 inch and 1 inch.
3. The degradation assembly of claim 1, wherein the tungsten carbide of the outer edge is segmented.
4. The degradation assembly of claim 1, wherein the tungsten carbide comprises a binder concentration of 4 to 35 weight percent.
5. The degradation assembly of claim 1, wherein the tungsten carbide comprises an average grain size between 0.5 μm and 200 μm .
6. The degradation assembly of claim 1, wherein the washer consists of a hardness greater than 58 HRC.
7. The degradation assembly of claim 1, wherein the washer is rotationally fixed to the holder.
8. The degradation assembly of claim 1, wherein the washer comprises a diameter to thickness ratio equal to or between 1:1 and 15:1 of a length of the body to a thickness of the washer.
9. The degradation assembly of claim 1, wherein the surface is polished.
10. The degradation assembly of claim 1, wherein the surface comprises a plurality of recesses.
11. The degradation assembly of claim 1, wherein the surface is beveled.
12. The degradation assembly of claim 1, wherein the attack tool is stationary with respect to the holder.
13. The degradation assembly of claim 1, wherein the wear-resistant tip of the attack tool comprises a material with a hardness greater than 4,000 HK.
14. The degradation assembly of claim 1, wherein the binder comprises a concentration between 4 and 10 percent.
15. The degradation assembly of claim 1, wherein the coating is disposed on an outer edge and is continuous.
16. The degradation assembly of claim 1, wherein the coating is 0.010 to 0.250 inches.
17. The degradation assembly of claim 1, wherein the washer comprises recesses.
18. The degradation assembly of claim 1, wherein the washer comprises a beveled surface.

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,413,256 B2
APPLICATION NO. : 11/463962
DATED : August 19, 2008
INVENTOR(S) : David R. Hall, Ronald Crockett and Jeff Jepson

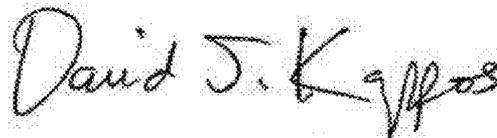
Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page, Item (56) References Cited:

“4,465,221 A 8/1984 Acharya” should be amended to read “4,465,221 A 8/1984 Schmidt”

Signed and Sealed this
Twenty-third Day of August, 2011

A handwritten signature in black ink that reads "David J. Kappos". The signature is written in a cursive style with a large initial "D".

David J. Kappos
Director of the United States Patent and Trademark Office